Original Research Article

Coexistence of CVD in COPD: A Hospital Base Study

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Abstract

Background: Chronic Obstructive Pulmonary Disease (COPD) is a complex respiratory disease. Which is notorious for producing many comorbidities. This disease produces chronic inflammatory changes in the lungs which ultimately leads to cardiovascular and other associated diseases causing raised mortality and morbidity.COPD also leads to change in various biochemical parameters like atrial blood gas, serum electrolytes, etc. These changes may produce fatal effects on the heart with dangerous sequela. In the present study, we had tried to correlate these parameters to elucidate the magnitude of the relation between these two diseases. It was observed that heart disease is the most common comorbidity in patients with COPD. **Aim:** To study about the alteration in blood pH, blood gases, and serum electrolytes in COPD patients. To find out their correlation between COPD and CVD.**Materials and Methods:** A hospital-based study was done on confirmed 109 COPD patients based on spirometry. With these patients, arterial blood gas analysis was done to find out the blood pH, PO2, and PCO2 level along with serum electrolytes. Further echocardiography was carried out to confirm the cardiovascular disease among COPD patients. **Results:** In this study, the numbers of patients with moderate, severe, and very severe COPD were 35.78%, 45.87%, and 18.35% respectively. On echocardiography with COPD patients, 57(52.29%) cases had normal echocardiograph. While 52 patients (47.71%) were found with pulmonary arterial hypertension, 33 patients (30.28%) with dilated RA/RV, 25 patients (22.94%) with LVDD, and 24 patients (22.02%) with low LVEF. **Conclusion:** We found that there is a strong correlation between COPD and CVD.COPD if not treated or controlled at the early stage may lead to CVD, which is more dangerous than COPD. Biochemical parameters in our study show a strong statistical correlation between these two diseases.

Keywords: ABG,BloodpH,COPD, CVD, PCO2, PO2.

Introduction

Chronic obstructive pulmonary disease (COPD) is a major cause of chronic morbidity and mortality throughout the world.[1]Many people suffer from this disease for years and die untimely from it or its complications. COPD is a common, preventable, and treatable malady.[2] The coexistence of CVD in COPD patients is quite common.[3]COPD patients with comorbid CVD are at a high rate of morbidity with horrendous quality of life, orthopnea, and exercise intolerance.[4]The presence of cardiovascular disease (Pulmonary arterial hypertension, dilated RA/RV, left ventricular dysfunction, and low left ventricular ejection fraction) among COPD patients increases the risk of repeated aggravation and mortality.[5] Moreover, repeated aggravation of COPD along with lung dysfunction are associated with an increased risk of cardiovascular disease and mortality.[6] In COPD patients, due to breathing difficulty, derangement of blood gases commonly occurs, which causes hypercapnia and hypoxemia.[7]This derangement of blood gases alters the blood pH also. So respiratory acidosis and respiratory failure are common findings in COPD. ABG is usually done in these cases to have an idea of blood pH, PO2, and PCO2 status. These findings reflect the underlying pathology of the lungs and its interpretation indicates the COPD disease processes.[8,9]COPD can be diagnosed by measuring the FEV1/FVC using spirometry.[10]Further derangement of blood gases usually measured by arterial blood gas analysis, an invasive technique.[11]Cardio-vascular dysfunction evaluated by echocardiography.[12]

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Aim of the Study

The study was done in the Department of Respiratory Medicine, SRMS Medical college Bareilly and Department of Respiratory Medicine, Santosh Medical College Ghaziabad during the period of November 2017 to February 2020.

"The study was aimed to find out the alteration in blood pH, blood gases, and serum electrolytes in 109 confirmed COPD patients to find out the correlation between and its comorbid CVD.

Materials and Methods

A hospital-based study was done in the Department of Respiratory Medicine, SRMS Medical College Bareilly, and Department of Respiratory Medicine, Santosh Medical College Ghaziabad during the period of November 2017 to February 2020.

Sample Size: Prevalence of COPD lies between 6.5 to 7.7%.[13]We assumed 6.5% prevalence of COPD with 5% absolute error and 10%non-response rate, the estimated sample size comes to be 105.

Inclusion Criteria: confirmed COPD patients of the age group 40 to 80 years.

Exclusion Criteria: Patients suffering from pneumonia, tuberculosis, interstitial lung disease, lung carcinoma, other cancer, and HIV.

The study participants were subdivided into four categories mild, moderate, severe, and very severe COPD according to GOLD guidelines. All the study participants were asked about their socio-

economic status, smoking habits, history of dyspnoea, duration of breathlessness, family history of respiratory disease, and diabetes mellitus with a well-defined questionnaire. Written consent has been taken from all the participants prior to the data collection.COPD was diagnosed by spirometry machine-schiller SP-1. Before performing the spirometry test all the precautions were strictly followed by the supporting staff. With spirometry FVC (Forced vital capacity), FEV1 (Forced expiratory volume in 1st second), and FEV1/FVC ratio were measured. All confirmed COPD patients underwent Arterial blood gas analysis by ABL Radiometer-800.To confirm the cardiovascular disease two-dimensional echocardiography was done by Siemens Acuson X-300 Premium edition. Collection of blood sample: A blood sample for arterial blood gas analysis was collected using a pre-heparinized syringe by arterial puncture by a phlebotomist.

Results

In the present study, we investigated total 109 patients of which 91 males and 18 females. The mean age of patients was 61.49 years. The mean BMI of patients was 20.73 kg/m^2. Out of 109 patients, 85 patients (77.98%) were smokers. Most of the smokers were having 10 or more than 10 pack-year smoking history. Based on COPD severity 39 patients were included in moderate,50 patients in severe, and 20 patients in the very severe COPD group. We had no patients with mild COPD. (Table-1)

On echocardiography 57 patients (52.29%) were not having any cardiovascular disease, 52 patients (47.71%) had pulmonary arterial hypertension (PAH), 33 patients (30.28%) had dilated right atrium/right ventricle,25 patients had (22.94%) left ventricular diastolic dysfunction followed by 24 patients (22.02%) with low left ventricular ejection fraction. As the severity of COPD increases, findings of cardiovascular disease significantly increase. (Table -2)

In the present study, none of the study participants was found to be having hyperkalemia, hence alkalosis was ruled out. 44 % of patients were maintaining the normal blood pH while 55.96 % of patients were found to be having mild to severe acidosis. Out of 50 severe COPD patients, 31 patients had mild (12) to severe (19) acidosis. While out of 20 very severe patients, 15 patients had mild (4) to severe (11) acidosis. 44 patients (40%) were found to be having normal PCO2 level. None of the patients included in the very severe COPD group had normal PCO2 level.60% of COPD patients (37+28=65) were found to be having hypercapnia, with impending respiratory failure. Among these 65 hypercapnic patients, 56 patients (86.15%) were included in the severe to very severe COPD group. 16 patients (14.68 %) were found with normal PO2 levels. While remaining 93 patients (85.32%) were found in hypoxemia condition facing the impending (53) to severe (40) respiratory failure. Further among these 93 patients,63 patients (67.74%) were included in the severe (43) to very severe (20) COPD group. In present study 69 COPD patients (63.30%) were found with normal serum sodium level, there was no significant change in sodium level of all categories of COPD patients. Here patients included in the very severe COPD group were also found with normal serum sodium level. The majority of COPD patients (66 patients; 60.55%) were found to be having hypokalemia. It may be noted that 56 patients (out of these 66 hypokalemic patients) were having severe (36) to very severe (20) COPD. Further, 100% of patients included in the very severe COPD group found with hypokalemia condition. (Table-3)

In present study PAH were found in 52 patients.33 PAH patients from them were having mild (13) to severe acidosis (20) and 19 PAH patients were maintaining the normal blood pH. However, 11 PAH (11/52) patients were having normal blood CO2 level and 41 PAH patients (41/52) were in respiratory failure condition.57 COPD patients had no pulmonary arterial hypertension. However, 33 no PAH patients were found to be having normal blood Co2 level, while 24 no PAH were in respiratory failure condition. It was observed that 48 PAH patients were found with hypoxemia facing impending to severe respiratory failure. 69 out of 109 patients with or without PAH were found with normal serum sodium level.66 out of 109 COPD patients with or without PAH were found to be having hypokalemic. (Table:4)

Table 1: COPD patient distribution

COPD stages according to GOLD criteria			No of Patients	
Grade	**FEV1/FVC(%of predicted)**	**COPD severity**	**Nos**	**%**
GOLD 1	≥80	Mild	0	0
GOLD 2	50-79	Moderate	39	35.78
GOLD 3	30-49	Severe	50	45.87
GOLD 4	< 30	Very severe	20	18.35

Table 2: Comparison between severity of COPD and cardiac changes

Cardiac Changes		ModerateCOPD(39)	Severe COPD(50)	Very SevereCOPD (20)	Statistical analysis
Pulmonary arterial hypertension (PAH)	No	26	28	3	$\chi2$=14.6548 p=0.000657
	Yes	13	22	17	
Dilated right atrium/ventricle	No	35	36	5	$\chi2$=26.4785 p<0.00001
	Yes	4	14	15	
Left ventricular diastolic dysfunction	No	36	42	6	$\chi2$=31.5515 p<0.00001
	Yes	3	8	14	
Low left ventricular ejection fraction (<55%)	No	36	42	7	$\chi2$=27.2352 p<0.00001
	Yes	3	8	13	

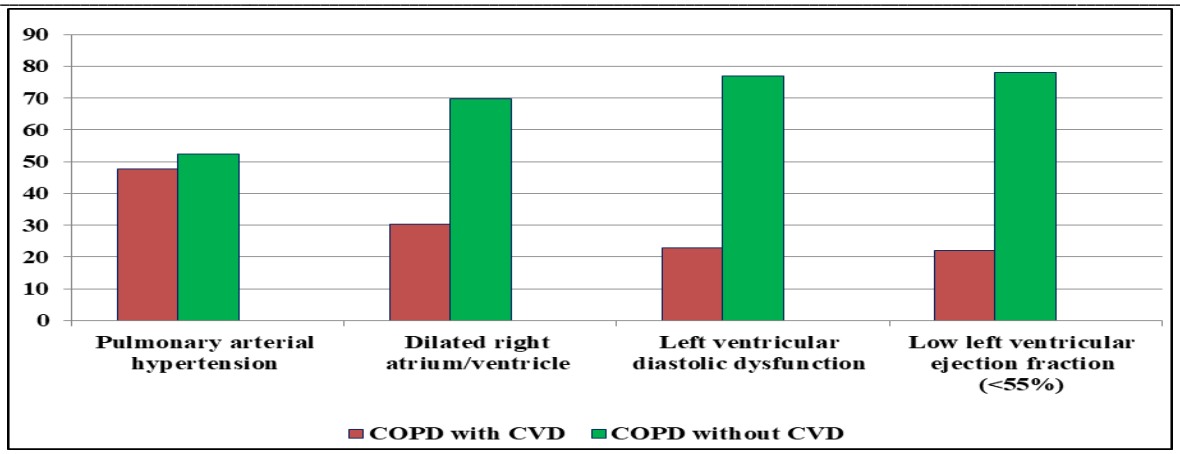

Fig 1:CVD findings in COPD

Table 3:COPD severity relationship with Blood pH, PCO2, PO2 level and serum electrolytes

COPD grades according to GOLD	Blood pH				Blood CO2 level			Blood O2 level			Sodium level			Potassium level		
	Normal 7.35 ≤7.45	Mild Acidosis 7.30-7.35	Severe acidosis <7.30	Alkalosis >7.45	Normal 35-45	Respiratory failure 45<60	Severe respiratory failure >60	Normal >80	Impending Respiratory Failure 60-80	Severe Respiratory failure < 60	Normal 135≤145	Hyponatremia <135	Hypernatremia>145	Normal 3.5≤5.5	Hypokalemia <3.5	Hyperkalemia >5.5
Moderate	24	11	4	0	30	6	3	9	27	3	24	13	2	29	10	0
Severe	19	12	19	0	14	22	14	7	24	19	28	18	4	14	36	0
Very Severe	5	4	11	0	0	9	11	0	2	18	17	1	2	0	20	0
Total	48	27	34	0	44	37	28	16	53	40	69	32	8	43	66	0
Percentage	44.04	24.77	31.19	0	40.37	33.94	25.69	14.68	48.62	36.7	63.3	29.36	7.34	39.45	60.55	0
Statistical analysis	$\chi2$ =15.011 p=0.005 at DF-4 significant				$\chi2$ =40.756 p = 0.000 at DF-4 significant			$\chi2$ =38.820 p=0.000 at DF-4 significant			$\chi2$ =7.413 p=0.116 Df-4 non-significant			$\chi2$ =35.671 p= 0.08 at df-2 non-significant		

Table 4: PAH relationship with Blood pH,PCO_2, PO_2 level and Serum electrolytes

PAH	Blood pH				PCO_2			PO_2			Serum Sodium			Serum Potassium		
	Normal 7.35 ≤7.45	Mild Acidosis 7.30-7.35	Severe acidosis <7.30	Alkalosis >7.45	Normal 35-45	Respiratory failure 45<60	Severe respiratory failure >60	Normal >80	Impending Respiratory Failure 60-80	Severe Respiratory failure < 60	Normal 135≤145	Hyponatremia <135	Hypernatremia>145	Normal 3.5≤5.5	Hypokalemia <3.5	Hyperkalemia >5.5
NO PAH	29	14	14	0	33	12	12	12	32	13	40	13	4	28	29	0
PAH	19	13	20	0	11	25	16	4	21	27	29	19	4	15	37	0
Total	48	27	34	0	44	37	28	16	53	40	69	32	8	43	66	0
Statistical analysis	χ^2 =2.9561. p=.228087. not significant at p< .05.				χ^2=15.9432. p= .000345. significant at p< .05.			χ^2 =10.9768. p=.004135. significant at p< .05.			χ^2 =2.6549. p=.265159. not significant at p< .05			χ^2 =4.6804. p=.030508. significant at p< .05.		

Discussion

COPD is a chronic lung disease of the elderly group that usually affects people after the 4th decade of life. This report was published in medical news also.[14] Due to the respiratory problems in COPD, hypoxemia, hypercapnia, and dyselectrolytemia along with acidosis were the most common findings in our study.Which is also reported by Cosimo Marcello Bruno et al.[15]We observed that more than 60% (66/109) COPD patients were having hypokalemia. Out of these hypokalemic patients, 84% had severe to very severe COPD as indicated in spirometric findings (Table:3). Hypoxemia, hypercapnia, acidosis, and dyselectrolytemia increases with the severity of COPD. Which is the same reported by Md Haroon et al.[16] These findings

ultimately lead to cardiovascular disease. It may be mentioned that though these anomalies can be corrected on their onset, overlooking these conditions can be life-threatening. There are various cardiac manifestations due to COPD. Impaired functioning of the pulmonary artery and atrium or ventricle are most common to complicate COPD and all these increase morbidity and mortality among COPD patients. Cardiovascular disease findings increase with the severity of COPD. In the present study population, pulmonary arterial hypertension has been a major finding. One possible reason for this high prevalence of pulmonary hypertension could be selection bias that favored ordering echocardiogram in patients with clinical features of pulmonary hypertension. The findings of our study appear to be like previous studies in respect of PAH which increases with the severity of COPD. After reviewing the medical records, it was observed that due to the complexity of CVD in COPD patients frequently overlooked.

The treating physician frequently advised echocardiography to exclude the presence of cardiac failure rather than diagnosing PAH, dilated RA/RV, and LVDD. It is felt that when COPD patients progress towards comorbid CVD diagnosis of PAH is important and treatment should be accorded immediately.

Conclusion

Our study showed a high prevalence of cardiovascular disease in COPD patients. Acidosis, hypercapnia, hypoxemia, and hypokalemia are common findings in COPD patients, which may raise PAH. It leads to comorbid CVD in chronic COPD cases. Stress must be given for the early diagnosis of PAH in COPD patients. Treatment of PAH, electrolyte, and blood gas imbalance must be undertaken in chronic COPD cases by early intervention to prevent this dangerous comorbid condition.

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